strong convectional action, and as the formation of hail is dependent upon strong upward air currents, this period would be unusually favorable for the formation of hail.

From April there is a gradual decrease in the temperature increase for the State as a whole, and by August the change is a decrease in temperature. By referring to the table of hailstorms for each month it will be seen that there is a gradual decrease in the number of storms from May to August and September.

As hailstorms are an accompaniment of thunderstorms it is interesting to observe how many thunderstorms occur during the season.

Average number of thunderstorms each month.

Stations.	April.	May.	June.	July.	August.	September.	Seasonal.
Sioux City, Iowa	2.9	6.8	9.5	8.5	8.2	4.9	40.8
Omaha	3.6	7.6	9.7	8.6	8.5	5.7	43.7
Lincoln	3.8	7.2	10.1	9.9	9.2	6.3	46.5
York	3.7	8.6	11.3	10.8	11.5	6.0	51.9
Marquette	2.9	5.6	8.5	8.3	8.6	4.5	38.4
Oakdale	2.8	5.9	7.3	8.1	7.6	4.7	36.4
Valentine	1.4	4.9	9.4	8.4	8.6	3.8	36.5
North Platte	2.3	6.4	9.6	9.7	9.0	3.1	40.1
Cheyenne, Wyo	2.0	6.7	11.0	13.4	12.6	4.9	50.6
Means	2.7	6.6	9.4	9.0	8.9	4.9	41.8

For the State as a whole there is a gradual increase in the number of thunderstorms from April to June, and a decrease from June to September. June, July, and August, respectively, are the months of greatest frequency. There is a rapid decrease during September, and this month has a little more than half as many as August. The increase from April to May is rapid, more than twice as many thunderstorms occurring in May as in April.

In the eastern and northern portions of the State the month of greatest frequency is June. No set rule seems to apply to the remainder of the State. The period of maximum number of storms, however, is in one of the three months, June, July, or August, and seems to be a little later in the season in the central portion of the State than in the western. April is uniformly the month of fewest storms.

The total number of thunderstorms for the season, April to September, inclusive, varies from an average of 38 in the northern portion of the State to an average of 47 in the southern. In the northern portion there is a slight increase from 41 at the Missouri River to the westward, while in the southern portion there is an increase from 44 at the river to about 50 in the center of the State. Continuing westward there is a decrease to about 40, followed by an increase to about 50 at the western border of the State. The average number of storms for the State as a whole is about 42 each season.

As these tables indicate, all thunderstorms are not accompanied by hail. Some authorities state that from one-half to one-tenth of all thunderstorms are accompanied by hail. While this may be the case in some parts of the country, it does not hold true for Nebraska.

Percentage of thunderstorms accompanied by hail.

Stations.	April.	May.	June.	July.	August.	September.	Seasonal.
Sioux City, Iowa	16.1	14.6	6.1	2.5	3.7	5.4	6.6
Omaha	23.5	14.6	4.9	2.5	1.2	6.4	7.1
Lincoln	19.2	10.3	5.2	3.2	4.0	5.0	6.5
York	23.8	13.7	5.7	2.2	2.6	3.9	6.7
Marquette	13.5	8.8	8.5	6.7	4.5	3.7	7.1
Oakdale	14.8	15.9	15.8	5.2	4.2	7.9	10.0
Valentine	22.2	15.2	6.2	6.2	6.1	0.0	7.0
North Platte	15.9	12.4	4.9	6.0	5.8	1.7	6.9
Cheyenne, Wyo	26.3	21.9	23.1	9.8	9.6	18.1	15.7
Means	18.6	13.2	7.2	4.3	4.0	4.2	7.2

The above table gives the percentages of thunderstorms in Nebraska accompanied by hail in the different portions of the State. For the whole State, the greatest percentage is in April, when 18.6 per cent of all thunderstorms is accompanied by hail. As the season advances and thunderstorms become more frequent, the percentage is less, with a general decrease to August, when there is but 4 per cent. September has 4.2 per cent, or 0.2 per cent more than August.

Considering the State as a whole, 7.2 per cent of all thunderstorms is accompanied by hail. The lowest percentage seems to be in the southeastern portion of the State and the greatest in the western portion, with a secondary maximum in the central counties.

The general movement of hailstorms is from a westerly to an easterly direction. The path over which hail falls is usually of limited area. It is, in fact, quite common for the crops over but a small area to be damaged. This must not be misconstrued to mean, however, that this particular small area suffers loss year after year.

Hailstones of unusual size have been reported from various sections of the State. Authentic reports of hailstones as large as hens' eggs are not unusual, while occasionally hailstones even larger are reported. During a hailstorm at Stanton on April 25, 1893, the observer reported "hailstones 2 to 3 inches in diameter." At Madison a hailstone "3½ inches long" was reported by the cooperative observer during a storm on May 11, 1896. A hailstone "7¼ inches in circumference" was reported at Hebron April 18, 1893, and one "7½ inches in circumference" at Nebraska City on September 5, 1898. The observer at Hayes Center entered on the official record for August 11, 1910, "Terrific hailstorm; hailstones 9 inches in circumference," and on May 31, 1900, noted "hailstones 2½ inches in diameter."

Hailstones of this size kill small animals and birds, literally pound the crops into the ground, strip small branches from trees, break windows, and even damage the walls and roofs of frame buildings. Great destruction is sometimes left in the path of such a storm. Fortunately, however, storms of this intensity are the exception rather than the rule in Nebraska.

LARGE HAILSTONES AT KANSAS CITY, MO., MAY 14, 1898.

At 7:25 p. m. hail began (the dividing line was about 75° zenith distance), the stones being of enormous size, rendering insignificant all previous records of hail at this station. The hail ended at 7:37 * * *. The official in charge measured between 15 and 20 of the largest hailstones and found them to range from 8 to 9½ inches in circumference. They were unusually well-formed and very solid. Quite a number were almost spherical; the majority were egg-shaped with one side rather flat. Very few had irregular surfaces or protuberances. The larger ones, when cut, showed 7 and 8 concentric layers outside the core. They were frozen hard, and a number of the heavier stones sank their depth in lawns and vacant ground.

The width of the hail belt was about 4 miles, but the very large hail was confined to this city, the area being little less than 3 square miles.

The damage by hail was very great. South windows and skylights were broken in nearly every house in the central and eastern portions of the city. Greenhouses suffered almost complete destruction. Horses, pelted by the hail, ran in every direction. Several persons were injured in one way or another. The roofs of buggies and carriages afforded no protection against such bombardment. Slates were broken on roofs. Fruit trees in the

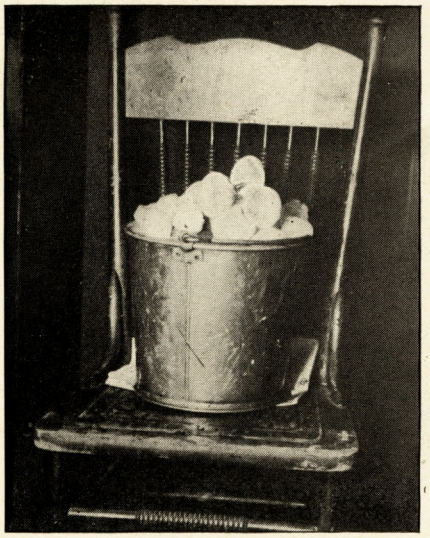


FIG. 1.—Hailstones "Taken over an hour after storm." (The farmer "made ice cream at night—had to break all pieces to go in freezer.")

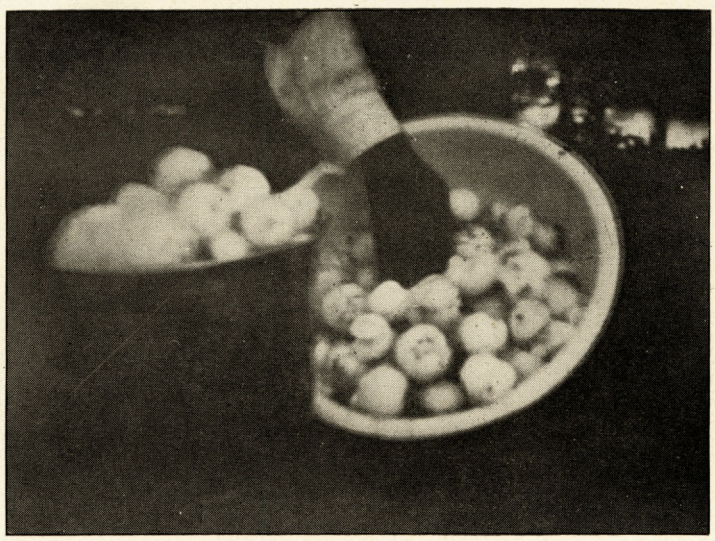


FIG. 2.—Hailstones picked up after a severe hailstorm.

FIG. 3.—An eave spout damaged by hail. Note the dents in the siding.

FIG. 4.—Rabbits killed by hailstones August 8, 1917, in York County. The three rabbits were found within a distance of half a mile.

FIG. 5.—Farm house in York County damaged by hail, August 8, 1917. The owner can testify as to the severity of the storm

eastern half of the city were stripped of fruit buds and foliage, and plants, flowers and vegetables were crushed to the ground.

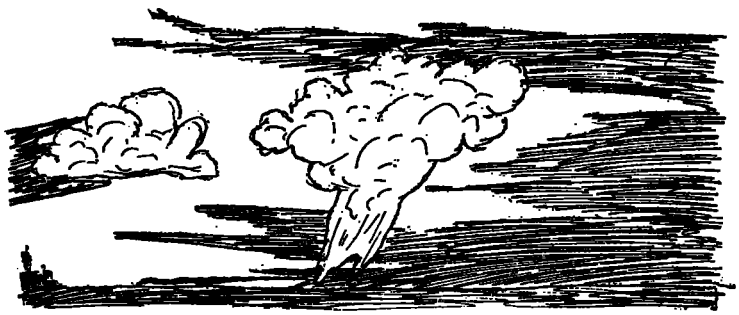
Prof. James A. Merrill, of the Manual Training High School of this city, informed the writer that he found one hailstone showing 11 concentric layers.

The accompanying picture is a copy of a photo made by a Kansas City man of hailstones that fell in the great storm of May 14, 1898. I had a negative made from the old photo, from which this print was made. The hailstones were placed on a brown cloth, the ground being covered with hail, together with two large hen eggs, each showing a small cross in order to show by contrast the size of the hailstones.

[A half-dozen of the principal losses alone totaled over $17,000.]—*P. Connor.*

FUNNEL CLOUD OVER LAKE MICHIGAN, JUNE 29, 1920.

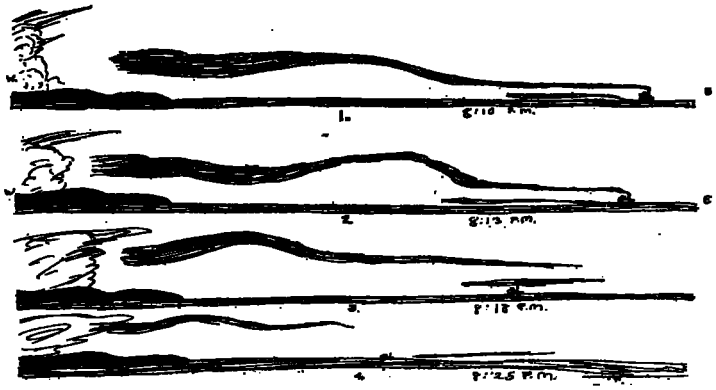
The cloud in the accompanying sketch was seen over Lake Michigan, on looking north from Chicago, at 7:08 p. m. (local summer time), June 29, 1920. The point of the cloud was actually considerably lower than the bulging top, and the drawing shows it as well as I



could represent it. No rotary motion was noticed in connection with the cloud. It changed shape rapidly, and by 7:13 had disappeared. A thundershower of moderate intensity followed within five minutes.—*Allen H. Ward.* This cloud probably marked a vortex which with but little further development would have made a waterspout.—*C. F. B.*

A SMOKE ARCH MARKING AN INCREASE IN WIND.

The sketch, which was made looking north from Chicago on the evening of August 6, 1920, shows a curious curve in a streak of smoke from a small steamer. A thunderstorm was approaching from the west, though it was still some distance away; and the wind was light



(Local Summer Time)

to gentle east to southeast. The curve was first noticed at 8:10 p. m., but became most pronounced three minutes later, with little change in position. By 8:18 it had moved westward considerably. It then began to fade away, and was last seen at 8:25, being then partly over land. At Chicago, the east wind shifted to southeast and increased from light to moderate about 15 minutes after the smoke had disappeared.—*Allen H. Ward.*

SOME FLYING EXPERIENCES IN "BUMPY" WEATHER IN TEXAS.

By D. P. CARLBERK.

[Excerpts from a letter to the Editor, Jan. 20, 1820.]

Entering Barron Field, Everman, Tex., as a cadet I flew there till I was commissioned and thereafter till I was ordered to Post Field in September. Having been both a cadet and an officer through a Texas summer I feel that I am quite familiar with most of the conditions treated in your article.[1]

The "bump" that worried me most was that kind I always thought of as a slender shaft of upcurrent. The big ones lift the whole ship but those wicked little ones kick one wing so sharply and so suddenly, I wondered whether I would ever get to the point where they would not scare me.

After a pilot gets to the place where he is accustomed to the roar of the motor, and the whistling of the wind through the wires, he can hear new sounds, and the contact of those upshoots—the "slender" ones—with the wing surface can actually be heard. It sounds as if someone under your wing had taken a hand full of sand and thrown it up against the wing—kind of a "biff" with a soft hiss to it.

One very hot day I was on a long cross-country flight. Fifteen miles south of Midlothian, Tex., I ran into a mess of "bumps" that were far worse than usual. I sat up and gave attention to the stick when suddenly a big fellow took me in charge—lifted me up about 500 feet and, regardless of my efforts and the power of the "Hispy," swiftly turned the whole ship completely around so that I started back toward the town. The twist seemed to come at the top of the current. I experienced the same twist on two different occasions after that. I could never understand it, unless it so happened by there being two large upcurrents side by side and as their overflows met at the top the twist was created, and that I was caught or tossed to one side, as I reached the top, and there met the twist (between the two "bumps").[2]

The height of "bumpiness" on any particular day does not remain constant. One day I flew for an hour at 5,000 feet. There was not a suggestion of a "bump" above 3,000 feet. When I landed, a pilot, ready to go up, asked me about the air. I had just landed so told him there was perfect air anywhere above 3,000 feet. I happened to be on the line when he came down and he told me that he had gone at once to 5,000 feet and the whole area was covered with "bumps."

Here is a peculiar thing which you doubtless will understand at once but was ever strange to me. It happened a half dozen times at Barron Field.

We always like to fly best in the early morning hours for the air was always good, but if that high, hot, wind—

[1] "Effect of winds and other conditions on the flight of airplanes, MONTHLY WEATHER REVIEW, August, 1919, 47 : 523-532.

[2] Upcurrents are frequently strongly rotational (especially in dust whirls), so only one convectional column would be sufficient to cause Mr. Carlberk's experience.—*C. F. B.*